HABITAT ECOLOGY OF ZYGOPTERAN (ODONATA) NYMPHS IN CERTAIN WATER BODIES OF MADHYA PRADESH [1]

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The distribution of zygopteran (Odonata) nymphs and their association with macrophytes in certain clean and polluted water bodies of Madhya Pradesh have been described. 16 species of zygopteran insects were identified on the basis of last instar nymphal stages. *Neurobasis chinensis chinensis* and *Pseudagrion spencei* were found at higher altitude (1067 m above msl) and *Copera marginipes*, *Ischnura delicata*, *I. rufostigma*, *Pseudagrion laidlawi* and *Rhodischnura nursei* were observed at lower altitudes (205 to 318 m above msl). *Copera marginipes*, *Ischnura rufostigma*, *Lestes praemorsa*, *Neurobasis chinensis chinensis*, *Pseudagrion laidlawi*, *P. spencei*, *Rhinocypha unimaculata* and *Rhodischnura nursei* preferred lotic waters. *Neurobasis chinensis chinensis* and *Pseudagrion spencei* inhabited acidic waters. *Copera marginipes* and *Rhinocypha unimaculata* were found in association with *Vallisneria spiralis* and *Eichhornia crassipes* respectively and *Ischnura rufostigma* along with decaying vegetation. Other species had no specific preference for the macrophytes. The zygopteran nymphs thus were found from clear to polluted waters at various altitudes in association with a variety of habitats.

INTRODUCTION

Most of the lakes in the world and many other aquatic systems are shallow and thus likely to offer sites for submerged macrophytic communities (Wetzel 1975). Such aquatic macrophytes may contribute considerably to the productivity of the water body and provide suitable places for hiding, breeding, egg laying, anchorage, rich oxygen supply and also the food supply for all groups of aquatic insects (Krecker 1939, Andrews and Hasler 1943, Cover and Harrel 1978, Das and Bisht 1979 and Pandit *et al.* 1985).

The insect and macrophyte communities in an aquatic ecosystem remain interdependent ecologically (Pandit *et al.* 1985) and therefore, a great interest in aquatic insects with regard to their habit and habitat in relation to the environment has been shown during recent years (McGaha 1952, Krull 1970, Soszka 1975a, Rosenberg 1986 and Kaushik *et al.* 1990). Observations on the distribution, habit and habitat of zygopteran (Odonata) nymphs from various water bodies of Madhya Pradesh in relation to their physico-chemical characteristics are presented here.

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MATERIAL AND METHODS

Various lentic and lotic water bodies at Pachmarhi, Reewa, Morena and Gwalior, situated at altitudes of 1067, 318, 300 and 205 m above msl respectively in Madhya Pradesh, were selected for the study.

Zygopteran nymphs were collected with the help of 'D' frame net made of nylon cloth (mesh size 80/sq. cm). The nymphs after segregation were preserved in 90% alcohol with a few drops of glycerin. Identification of these nymphs was based on the characteristics of last instar nymphal stages as suggested by Fraser (1957). Water temperature, dissolved oxygen, pH and chloride were also recorded immediately after collection of water samples at the sites as per the standard methods of APHA (1975). Macrophytes were also collected along the sampling station and preserved in 5% formalin.

The range of physico-chemical characteristics, distribution of zygopteran nymphs and their association with macrophytes have been given in Tables 1, 2 and 3 respectively.

RESULTS AND DISCUSSION

The physico-chemical characteristics and abundance of macrophytes influence the distribution of aquatic communities including insects (Pandit *et al.* 1985, Kaushik *et al.* 1990). Out of

TABLE 1
RANGE OF TOLERANCE OF PHYSICO-CHEMICAL CHARACTERISTICS IN VARIOUS ZYGOPTERAN NYMPHS

Name of the species	Altitude (m) above mean sea level	Water colour	Water temperature (°C)	Dissolved oxygen (mg/l)	pH (mg/l)	Chloride
Neurobasis chinensis	1067	Clear	16-24	8.1-11.9	6.0-6.7	19-23
Rhinocypha unimaculata	318-1067	Clear-greenish	24-29	9.5-11.2	6.7-8.0	20-75
Agriocnemis pygmaea	205-1067	Clear-blackish	16-24	5.7-11.9	6.0-8.3	23-120
Ceriagrion coromandelianum	205-1067	Clear-greenish	16-29	8.1-11.9	6.0-8.3	23-114
Enallagma parvum	205-1067	Greenish-blackish	22-26	5.7-10.1	6.0-8.1	69-120
Ischnura delicata	205-318	Greenish	21-29	7.4-10.1	7.2-8.2	30-114
I. senegalensis	205-1067	Greenish-blackish	24-30	5.1-10.0	6.0-8.2	74-597
I. rufostigma	300	Greenish	22-24	7.4-10.1	7.2-7.5	69-74
Pseudagrion rubriceps	205-1067	Clear-blackish	16-30	5.1-11.9	6.0-8.3	23-597
P. laidlawi	300-318	Greenish	22-29	8.4-11.2	7.2-8.0	69-88
P. spencei	1067	Clear	24	8.1-9.5	6.5-6.7	19-20
Rhodischnura nursei	300	Greenish	22-24	7.4-10.1	7.2-7.5	69-74
Lestes praemorsa praemorsa	300-1067	Clear-greenish	16-24	8.4-11.9	6.0-7.8	23-74
Copera marginipes	300-318	Greenish	23-29	9.5-11.2	7.9-8.0	75-88

the water bodies selected — Big fall, Apsara vihar, Patthar chata and Matsya sarovar — the water was comparatively clean and clear while the water in Beehar, Bichhiya, Saank, Asaun, Kuari rivers and Ganga sagar tank was turbid and light green in colour due to the growth of phytoplankton. Lotus pool, Vivek nagar pond, Chandanpura pond and Moti mahal tank were polluted by domestic and municipal wastes, while J.C. Mill pond received cotton mill effluents.

Temperature and dissolved oxygen in environments have great bearing on both terrestrial and aquatic communities. Water temperature and dissolved oxygen were found to show a wide range of variation in the water bodies selected for the study. Highest water temperature and lowest dissolved oxygen was measured in J.C. Mill pond while lowest temperature and highest dissolved oxygen was observed in Big fall waters.

Hydrogen ion concentration of natural waters is another important environmental factor. Its variations are linked, among other causes, with the species composition and life processes of constituent biological communities (Jhingran 1982). The nature of all water bodies at Pachmarhi was found to be slightly acidic. It may be due to the presence of decaying vegetation. This decaying vegetation increased the concentration of CO_2 and thus decreased pH. These findings are in agreement with Irwin and Stevenson (1951). The alkaline nature (pH 7.2 to 8.3) of water bodies at Rewa, Morena, and Gwalior may be due to ionic composition and greater photosynthetic activity of algae (Goel *et al.* 1986).

Chlorides occur naturally in all types of waters. The most important sources of chloride in natural waters are from sewage discharge and industrial waste and the salts of sodium, potassium and calcium. The lowest chloride value (19 mg/l) was recorded in Patthar chata while the highest (597 mg/l) was found in J.C. Mill pond, indicating organic pollution (Table 1). Sharma *et al.* (1978) have also reported that increased chloride concentration of water is indicative of pollution.

16 species of zygoptera were identified, out of which 12 species belonging to Coenagriidae and 1 species each to Lestidae, Agriidae, Platycnemididae and Chlorocyphidae were recorded from various water bodies in Madhya Pradesh (Table 2). The distribution of zygopteran insects with regard to altitude indicates that *Neurobasis chinensis chinensis* and *Pseudagrion spencei* were recorded in hilly areas of Pachmarhi located at an altitude of 1067 m, while *Copera marginipes*, *Ischnura delicata*, *I. rufostigma*,

TABLE 2
HABITAT DISTRIBUTION OF ZYGOPTERAN NYMPHS IN CERTAIN WATER BODIES OF MADHYA PRADESH

Species	Pachmarhi				Rewa		Morena			Gwalior					
	1*	2*	3*	4**	5*	6*	7*	8*	9*	10**	11**	12**	13**	14**	15**
Family -AGRIIDAE															
Neurobasis chinensis chinensis	+	+	+	—	—	—	—	—	—	—	—	—	—	—	-
Family -CHLOROCYPHIDAE															
Rhinocypha unimaculata	—	+	—	—	—	+	—	—	—	—	—	—	—	—	-
Family -COENAGRIIDAE															
Agriocnemis pygmaea	+	—	—	+	—	—	+	+	—	—	—	+	—	—	-
Ceriagrion coromandelianum	+	—	—	—	—	+	+	+	+	—	—	+	+	—	-
Ceriagrion sp.	—	—	—	—	—	—	+	—	—	—	—	—	—	—	-
Enallagma parvum	—	—	—	+	—	—	—	+	—	—	—	—	—	+	-
Ischnura delicata	—	—	—	—	+	—	+	+	+	+	+	—	+	—	-
I. senegalensis	—	—	—	+	+	—	+	—	—	—	—	—	—	+	+
I. rufostigma	—	—	—	—	—	—	—	+	—	—	—	—	—	—	-
Ischnura sp.	—	—	—	—	—	—	—	—	+	—	—	+	—	—	-
Pseudagrion rubriceps	+	—	—	+	—	+	+	—	—	+	—	+	+	+	+
P. laidlawi	—	—	—	—	—	+	+	+	+	—	—	—	—	—	-
P. spencei	—	+	+	—	—	—	—	—	—	—	—	—	—	—	-
Rhodischnura nursei	—	—	—	—	—	—	—	+	—	—	—	—	—	—	-
Family-LESTIDAE															
Lestes praemorsa praemorsa	+	—	—	—	—	—	+	—	—	—	—	—	—	—	-
Family-PLATYCNEMIDIDAE															
Copera marginipes	—	—	—	—	—	+	—	—	—	+	—	—	—	—	-

1. Big fall, 2. Apsara Vihar, 3. Patthar chata, 4. Lotus pool, 5 Beehar river, 6. Bichhiya river, 7. Saank river, 8. Asaun river, 9. = Kuari river, 10. Matsya sarovar, 11 = Ganga sagar tank, 12. Vivek nagar pond, 13. Chandanpura pond, 14. Moti mahal tank, 15. J.C. Mill pond.
* = Lotic; ** = Lentic; + = Present; — = Absent.

TABLE 3
SHOWING ASSOCIATION OF MACROPHYTES AND ZYGOPTERAN NYMPHS

	Zygopteran species															
Macrophytic species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Potamogeton crispus	–	–	+	+	–	–	+	+	–	–	–	+	–	+	+	–
P. demersum	–	–	+	+	–	+	+	–	–	+	+	–	–	–	–	–
P.pectinatus	–	–	–	+	+	–	+	+	–	–	–	+	–	+	+	–
Vallisneria spiralis	–	–	+	+	–	+	–	+	–	+	+	+	–	+	+	+
Hydrilla verticillata	+	–	–	+	–	+	–	+	–	–	–	+	–	–	–	–
Cynodon dactylon	–	–	+	+	–	–	–	+	–	–	–	–	–	–	–	–
Lemna pancicostata	–	–	–	–	–	+	–	–	+	+	–	–	–	–	–	–
Ipomoea festulosa	–	–	–	+	–	–	–	+	–	–	+	+	–	–	–	–
Eichhornia crassipes	–	+	+	+	+	–	–	+	–	–	+	–	+	–	+	–
Ceratophyllum demersus	–	–	–	–	–	–	–	+	–	–	+	–	–	–	–	–
Utricularia stellaris	+	–	–	–	–	+	–	+	–	–	+	–	–	–	–	–
Jussiaea repens	–	–	+	–	–	–	–	+	–	–	+	–	–	–	–	–
Azolla sp.	–	–	–	–	–	–	–	+	–	–	+	–	–	–	–	–
Zennichellia sp.	–	–	–	+	–	+	–	–	–	+	+	–	–	–	–	–
Decaying vegetation	+	–	–	–	–	–	+	–	+	–	–	+	+	–	+	–

1. *Neurobasis chinensis chinensis*, 2. *Rhinocypha unimaculata*, 3. *Agriocnemis pygmaea*, 4. *Ceriagrion coromandelianum*, 5. *Ceriagrion* sp., 6. *Enallagma parvum*, 7. *Ischnura delicata*, 8 *I . senegalensis*, 9. *I. rufostigma*, 10. *Ischnura* sp., 11 *Pseudagrion rubriceps*, 12 . *P. laidlawi*, 13. *P. spencei*, 14. *Rhodischnura nursei*, 15. *Lestes praemorsa praemorsa*, 16. *Copera marginipes*. + Present; — Absent.

Pseudagiron laidlawi and *Rhodischnura nursei* were observed at an altitude of 205 m to 318 m only.

Agriocnemis pygmaea, *Ceriagrion coromandelianum*, *Enallagma parvum*, *Ischnura senegalensis*, *Lestes praemorsa praemorsa*, *Pseudagrion rubriceps* and *Rhinocypha unimaculata* were widely distributed from higher to lower altitudes.

Copera marginipes, *Ischnura rufostigma*, *Lestes praemorsa praemorsa*, *Neurobasis chinensis chinensis*, *Pseudagrion laidlawi*, *P. spencei*, *Rhinocypha unimaculata* and *Rhodischnura nursei* indicated their preference for lotic water, while other species were present in both lotic as well as lentic waters.

Pseudagrion rubriceps was observed in both clean and polluted waters and thus accepted a wide range of water temperature and chloride concentration (Table 1). *Ischnura senegalensis* was found in waters with high concentration of chloride. Hynes (1974), Roback (1974) and Perry (1981) have also reported similar observations regarding the tolerance for a wide range of physico-chemical characteristics of water by species of *Ischnura*. *Neurobasis chinensis chinensis* and *Pseudagrion spencei* were collected from hilly lotic waters with slightly acidic pH and low concentration of chlorides (Table 1).

Since macrophytes provide food and shelter to many macroinvertebrate communities in water, the former have been found to harbour zygopteran nymphs also. The association of various zygopteran nymphs with different species of macrophytes has been shown in Table 3. *Ceriagrion coromandelianum*, *Ischnura senegalensis* and *Pseudagrion rubriceps* have been found in association with at least 10 species of macrophytes without any specific preference. *Copera marginipes* and *Rhinocypha unimaculata* have strong affinity for *Vallisneria spiralis* and *Eichhornia crassipes* respectively, while *Ischnura rufostigma* was always found along with decaying vegetation. However, *Rhinocypha unimaculata* and *Ceriagrion coromandelianum* were also observed clinging to rocks and algal growth in water respectively.

Odonatan nymphs are believed to inhabit clean waters with sufficient oxygen (Tonapi 1980). This is, however, not true in the present study. The zygopteran nymphs have been observed from clean to polluted waters and were found to prefer a variety of macrophytic habitat as has been suggested by Roback (1974), Hynes (1974) and Perry (1981).

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